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Society of Nuclear Medicine and Molecular Imaging (SNMMI)
Technologist Section
Scope of Practice for Nuclear Medicine Technologists
Revised 2011

This document is not intended to modify or alter existing tort law; rather it should serve as a concise outline of nuclear medicine technology skills and responsibilities.

NUCLEAR MEDICINE TECHNOLOGY

Nuclear medicine, which includes molecular imaging, is the medical specialty that utilizes sealed and unsealed radioactive materials in the diagnosis and therapy of various diseases. This practice also includes the utilization of pharmaceuticals (used as adjunctive medications) and other imaging modalities with or without contrast to enhance the evaluation of physiologic processes at a molecular level. The nuclear medicine technologist is an allied health professional who, under the direction of an authorized user, is committed to applying the art and skill of their profession to optimize diagnostic evaluation and therapy through the safe and effective use of radiopharmaceuticals and adjunctive medications.

The practice of nuclear medicine technology requires multidisciplinary skills that are needed to use rapidly evolving instrumentation, radiopharmaceuticals, adjunctive medications and techniques. The responsibilities of the nuclear medicine technologist include, but are not limited to, patient care, quality control, diagnostic procedures, radiopharmaceutical and adjunctive medication, preparation and administration, in vitro diagnostic testing, radionuclide therapy, and radiation safety. The nuclear medicine technologist can also participate in research.

In order to perform these tasks, the nuclear medicine technologist must successfully complete didactic and clinical education. Education includes, but is not limited to, methods of patient care, immunology, cross sectional anatomy, pharmacology, nuclear medicine and radiation physics, radiation biology, radiation safety and protection, nuclear medicine instrumentation, quality control and quality assurance, computer applications for nuclear medicine, general diagnostic nuclear medicine procedures, radionuclide therapy, positron emission tomography (PET), computed tomography (CT), radionuclide chemistry, radiopharmacy, medical ethics and law, healthcare administration, health sciences and research methods, and medical informatics.

Graduates of accredited programs are eligible to sit for certification examinations offered by the Nuclear Medicine Technology Certification Board and the American Registry of Radiologic Technologists. The spectrum of the nuclear medicine technologist's responsibilities varies widely across the country and may exceed basic skills outlined in the technologist's initial education and certification. Practice components presented in this document provide a basis for establishing the areas of knowledge and performance for the nuclear medicine technologist. It is assumed that for all activities included in this scope of practice, the nuclear medicine technologist has received the proper education and is in compliance with all federal, state and institutional guidelines including proper documentation of initial and continued competency in those practices and activities. Continuing education is a necessary component in maintaining the skills required to perform all duties and tasks of the nuclear medicine technologist in this ever-evolving field.

THE SCOPE OF PRACTICE

The scope of practice in nuclear medicine technology includes, but is not limited to, the following areas and responsibilities:

• **Patient Care:** Requires the exercise of judgment to assess and respond to the patient's needs before, during and after diagnostic imaging and therapeutic procedures and in patient medication reconciliation. This includes record keeping in accordance with the Health Insurance Portability and Accountability Act (HIPAA).

• **Quality Control:** Requires the evaluation and maintenance of a quality control program for all instrumentation to ensure optimal performance and stability.

• **Diagnostic Procedures:** Requires the utilization of appropriate techniques, radiopharmaceuticals and adjunctive medications as part of a standard protocol to ensure quality diagnostic images and/or laboratory results.

• **Radiopharmaceuticals:** Involves the safe handling and storage of radioactive materials during the procurement, identification, calibration, preparation, quality control, dose calculation, dispensing documentation, administration and disposal.

• **Adjunctive Medications:** Involves the identification, preparation, calculation, documentation, administration and monitoring of adjunctive medication(s) used during an in-vitro, diagnostic imaging, or therapeutic procedure. Adjunctive medications are defined as those medications used to evoke a specific physiological or biochemical response. Also included are the preparation and administration of oral and IV contrast used in the performance of imaging studies.

• **In Vitro Diagnostic Testing:** Involves the acquisition of biological specimens with or without oral, intramuscular, intravenous, inhaled or other administration of radiopharmaceuticals and adjunctive medications for the assessment of physiologic function.

• **Operation of Instrumentation:** Involves the operation of:

• Imaging instrumentation:

o Gamma camera systems with or without sealed sources of radioactive materials or x-ray tubes for attenuation correction, transmission imaging or diagnostic CT (when appropriately educated, trained and credentialed).

o PET imaging systems with or without sealed sources of radioactive materials or x-ray tubes for attenuation correction, transmission imaging or diagnostic CT (when appropriately trained and credentialed)

• Non-imaging instrumentation:

o Dose calibrators

o Survey instrumentation for exposure and contamination

o Probe and well instrumentation

o Ancillary patient care equipment as authorized by institutional policies.

• **Radionuclide Therapy:** Involves patient management, preparation and administration of therapeutic radiopharmaceuticals, under the personal supervision of the Authorized User

• **Radiation Safety:** Involves practicing techniques that will minimize radiation exposure to the patient, health care personnel and general public, through consistent use of protective devices, shields, and monitors consistent with ALARA (as low as reasonably achievable) and establishing protocols for managing spills and unplanned releases of radiation.

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Clinical Performance Standards FOR THE NUCLEAR MEDICINE TECHNOLOGIST (Revision 2011)

The Clinical Performance Standards for the Nuclear Medicine Technologist were initially developed by the Socio Economic Affairs Committee and approved in 1994 periodically revised as the profession and educational requirements evolved. Over this past year, the SNMTS Scope of Practice Task Force has worked to revise the SNMTS Scope of Practice to serve more as an overview of responsibilities, allowing the Clinical Performance Standards (previously the Performance and Responsibility Guidelines) to serve as the task list for nuclear medicine technologists.

The spectrum of nuclear medicine technology skills and responsibilities varies widely across the country. The broad descriptions of this document will provide a basis for determining the areas of knowledge and of performance for the nuclear medicine technologist. The documents used in the revision and development of these guidelines were the Society of Nuclear Medicine Technologist Section (SNMTS) Performance and Responsibility Standards for the Nuclear Medicine Technologist (2003); Nuclear Medicine Technology Certification Board (NMTCB) Report: Components of Preparedness (2009); NMTCB, SNMTS Scope of Practice (2009); Nuclear Medicine Technology Entry-Level Curriculum Guide, 4th Edition; and the Accreditation Standards for Nuclear Medicine Technologist Education (2011). These guidelines should be considered a helpful checklist of those skills necessary to perform a variety of nuclear medicine procedures. Although the editors tried to be complete, nuclear medicine technology is a dynamic and evolving field; therefore, any list is likely to be partially obsolete as soon as it is issued. In addition, this document is not designed to be a "how to" description for any of the listed activities, nor is it intended to be used to represent entry level competencies, but rather the spectrum of NMT general responsibilities. It is not intended to modify or alter existing tort law.

Nuclear medicine, which includes molecular imaging, is the medical specialty that utilizes sealed and unsealed radioactive materials in the diagnosis and therapy of various diseases. This practice also includes the utilization of pharmaceuticals (used as adjunctive medications) and other imaging modalities with or without contrast to enhance the evaluation of physiologic processes at a molecular level. The nuclear medicine technologist is an allied health professional who, under the direction of an authorized user, is committed to applying the art and skill of their profession to optimize diagnostic evaluation and therapy through the safe and effective use of radiopharmaceuticals and adjunctive medications.

Nuclear Medicine Technology

The practice of nuclear medicine technology requires multidisciplinary skills that are needed to use rapidly evolving instrumentation, radiopharmaceuticals, adjunctive medications and techniques. The responsibilities of the nuclear medicine technologist include, but are not limited to, patient care, quality control, diagnostic procedures, radiopharmaceutical and adjunctive medication, preparation and administration, in vitro diagnostic testing, radionuclide therapy, and radiation safety. The nuclear medicine technologist can also participate in research.

In order to perform these responsibilities, the nuclear medicine technologist must successfully complete didactic and clinical training. Recommended course work includes, but is not limited to: anatomy, physiology, pathophysiology, pharmacology, chemistry, physics, mathematics, computer applications, biomedical sciences, ethics, and radiation health and safety. Direct patient contact hours are obtained by training in a clinical education setting and are a necessary component in maintaining the skills required to perform the duties and tasks of the nuclear medicine technologist.

Formal education programs in nuclear medicine technology are accredited by the Joint Review Committee on Educational Programs in Nuclear Medicine Technology (JRCNMT). Graduates of accredited programs are eligible to take the certification examination offered by the Nuclear Medicine Technologist Certification Board (NMTCB) and/or American Registry of Radiologic Technologists (ARRT).

The scope of performance in nuclear medicine technology includes, but is not limited to, the following areas and responsibilities:

Patient Care:
Requires the exercise of judgment to assess and respond to the patient's needs before, during and after diagnostic imaging and therapeutic procedures and in patient medication reconciliation. This includes record keeping in accordance with the Health Insurance Portability and Accountability Act (HIPAA).

In Vitro Diagnostic Testing:
Involves the acquisition of biological specimens with or without oral, intramuscular, intravenous, inhaled or other administration of radiopharmaceuticals and adjunctive medications for the assessment of physiologic function.

Instrumentation: Involves the operation of imaging instrumentation:

A. Gamma camera systems with or without sealed sources of radioactive materials or x-ray tubes for attenuation correction, transmission imaging or diagnostic CT (when appropriately educated, trained and/or credentialed).
B. PET imaging systems with or without sealed sources of radioactive materials or x-ray tubes for attenuation correction, transmission imaging or diagnostic CT (when appropriately trained and/or credentialed)
C. Bone density imaging systems with x-ray tubes
    1. Non-imaging instrumentation:
D. Dose calibrators
E. Survey instrumentation for exposure and contamination
F. Probe and well instrumentation
G. Ancillary patient care equipment as authorized by institutional policies.

Quality Control:
Requires the evaluation and maintenance of a quality control program for all instrumentation to ensure optimal performance and stability.

Diagnostic Procedures:
Requires the utilization of appropriate techniques, radiopharmaceuticals and adjunctive medications as part of a standard protocol to ensure quality diagnostic images and/or laboratory results.

Adjunctive Medications: Involves the identification, calculation, documentation, administration and monitoring of adjunctive medication(s) used during an in-vitro, diagnostic imaging, or therapeutic procedure. Adjunctive medications are defined as those medications used to evoke a specific physiological or biochemical response. Also included are the preparation and administration of oral and IV contrast used in the performance of imaging studies.

Radiopharmaceuticals:
Involves the safe handling and storage of radioactive materials during the procurement, identification, calibration, preparation, quality control, dose calculation, dispensing documentation, administration and disposal.

Radionuclide therapy:
Involves patient management, preparation and administration of therapeutic radiopharmaceuticals, under the personal supervision of the Authorized User.

Radiation safety:
Involves practicing techniques that will minimize radiation exposure to the patient, health care personnel and general public, through consistent use of protective devices, shields, dose reduction, and monitors consistent with ALARA (as low as reasonably achievable) and establishing protocols for managing spills and unplanned releases of radiation.

I. Patient Care

A. A nuclear medicine technologist provides patient care by:

1. providing for proper comfort and care to the patient prior to, during and after a procedure, including but not limited to the monitoring of intravenous lines (i.e.., central lines, peripherally inserted central catheters (PICC), oxygen supplies, drains; and operation of blood pressure cuffs, electrocardiogram (ECG) machines, pulse oximeters, glucometer intravenous pumps and oxygen delivery regulators.

2. insertion of peripheral intravenous catheters

3. monitoring patients who are under minimal sedation (in those facilities that approve such practice with subsequent documentation of competency of all monitoring staff in accordance with the American Society of Anesthesiology's [ASA] guidelines for conscious sedation).

3. establishing and maintaining proper communication with patients (i.e.,

proper introduction, appropriate explanation of procedure, etc.)

4. behaving in a professional manner in consideration and observation of patients' rights resulting in the provision of the highest quality patient care possible.

5. providing a safe and sanitary working environment for patients and the general public, using proper infection control practices in compliance with accepted precaution policies

6. Recognizing and responding to an emergency situation at a level commensurate with one's training and competency including cardiopulmonary resuscitation (CPR) ; the use of automatic external defibrillators (AED), if applicable, advanced cardiac life support (ACLS), advanced pediatric life support (PALS).

B. A nuclear medicine technologist prepares the patient by:

1. review the indication for the study for appropriateness and consulting with the authorized user and/or referring physician whenever necessary to ensure that the proper study is performed.

2. verifying patient identification, date of last menstrual period, pregnancy/breastfeeding status and written orders for the procedure.

3. obtaining a pertinent medical history including medications and allergies and confirming the patient's candidacy for the procedure.

4. assuring that any pre-procedural preparation has been completed (e.g., fasting, hydration, thyroid blocking, voiding, bowel cleansing, suspension of interfering medications.

5. assuring that informed consent has been obtained, as prescribed by the institution, whenever necessary.

6. properly explaining the procedure to the patient and/or family and, where appropriate, to the parent and/or legal guardian, and when necessary, obtain the assistance of an interpreter or translator This includes, but is not limited to, patient involvement, length of study, radiation safety issues, and post-procedure instructions.

7. Collecting and performing pertinent laboratory procedures

8. In vitro diagnostic testing laboratory analyses, including urine pregnancy testing and fasting blood sugar. Additionally, in vitro diagnostic testing laboratory procedures include, but are not limited to, secretions, saliva,

breath, blood, and stool, to measure biodistribution of radiopharmaceuticals.

C. A nuclear medicine technologist performs administrative procedures by:

1. maintaining an adequate volume of medical/surgical supplies, radiopharmaceuticals, storage media, and other items required to perform procedures in a timely manner.

2. scheduling patient procedures appropriate to the indication and in the proper sequence.

3. maintaining appropriate records of administered radioactivity, quality control procedures, patient reports, and other required records.

4. Developing and revising, when necessary, policies and procedures in accordance with applicable regulations.

5. Actively participating in total quality management/continuous quality improvement programs (i.e., age-specific competencies, patient education, and patient restraint and immobilization).

II. Instrumentation/Quality Control

A. A nuclear medicine technologist evaluates the performance of instrumentation by:

1. obtaining uniformity images on scintillation detectors.

   a) selecting a radionuclide source of appropriate type, size, quantity and energy;

   b) selecting an appropriate pulse height analyzer (PHA) photopeak and window;

   c) obtaining uniformity images using standardized imaging parameters;

   d) evaluating the images qualitatively and/or quantitatively in comparison to the manufacturer's specifications and the performance requirements based on the studies for which unit is used;

   e) identifying the source of any nonuniformity (e.g., checking collimator, PHA peak setting);

f) initiating corrective action when necessary; and

g) maintaining required records for the quality control program.

2. performing a detector linearity evaluation on scintillation detectors.

a) selecting a radionuclide, a linearity phantom and obtaining images;

b) identifying any nonlinear distortion in the image;

c) determining the source of nonlinearity. (e.g., detector-source geometry);

d) initiating corrective action when necessary; and

e) maintaining required records for the quality control program.

3. performing spatial resolution checks on scintillation detectors.

a) selecting an appropriate radionuclide;

b) choosing a phantom that is compatible with the specified resolution of the camera;

c) analyzing the resulting images for degradation of resolution;

d) initiating corrective action when necessary; and

e) maintaining required records for the quality control_program.

4. conducting sensitivity checks on scintillation detectors.

a) selecting a source with an appropriate level of activity and half-life;

b) assuring identical geometry, source placement and measurement parameters for repetitive checks;

c) evaluating results;

d) initiating corrective action when necessary; and

e) maintaining required records for the quality control program.

5. performing single photon emission computed tomography (SPECT) quality control procedures.

   a) obtaining a high count uniformity flood;

   b) verifying center of rotation correction;

   c) verifying energy correction and spatial coordinates;

   d) verifying multi-head detector alignment;

   e) evaluating reconstruction results of phantom acquisition;

   f) analyzing the results for degradation;

   g) initiating corrective action when necessary; and

   h) maintaining required records for the quality control program.

6. performing and evaluating quality control procedures for positron emission tomography (PET) and computed tomography (CT) imaging systems.

   a) evaluating the performance of PET and hybrid PET/CT systems:

      (i) with an intimate knowledge of PET detectors, types of crystals (e.g., BGO, LSO, GSO, NaI), transmission sources of various configurations, retractable rod sources/septa, ring planes, and methods of coincidence detection.

      (ii) identifying system-specific quality control requirements by following recommended initial acceptance, daily, weekly, monthly, quarterly, and annual quality control procedures to evaluate allowable parameter ranges for:

         a) photon detection/discrimination
         b) spatial resolution
         c) scatter reaction
         d) count loss
         e) random measurement
         f) sensitivity
         g) deadtime loss and random count correction accuracy

(iii) recognizing image artifacts requiring imaging system correction and performing corrections and quality assuranance as directed by institutional and manufacturer recommendations.

a) sinogram acquisition and evaluation
b) well counter SUV calibration;
c) PET/CT system alignment calibration;
d) CT system quality assurance;
e) glucometer quality assurance using high and low standards;

f) rubidium generator quality assurance to include dose calibrator/generator calibration and parent/daughter breakthrough is this in the correct location??

(iv) assisting with the development of 2D and 3D tomographic normalization algorithms used for image acquisition, recontruction, and display.

(v) demonstrating knowledge and technical skills in computed tomography (CT) when used to perform PET/CT examinations.
a) x-ray production
b) radiographic techniques
c) scanning parameters (MA, kVp, pitch, and helical scanning)

7. verifying computer parameter settings and data interface.

a) assuring that the camera detector and computer register the same count rate at the maximum frame rate;

b) verifying that the camera detector and computer have the same image orientation;

c) obtaining a dead time measurement on the computer;

d) verifying accuracy of ECG gating;

e) performing pixel calibration; and

d) operating PET computer hardware, processing software and basic Windows and Unix platforms.

8. ensures the proper performance of imaging systems,

storage media, and radiation detection and counting devices, including but not limited to scintillation cameras, dose calibrators, survey instruments, scintillation probes and well counters, and data processing and image production devices.

9. Maintaining and operating auxiliary equipment used in nuclear medicine procedures

10. A nuclear medicine technologist actively participates in total quality management/continuous quality improvement programs by:

    a) identifying indicators to be analyzed;

    b) gathering and presenting data in appropriate formats; and

    c) analyzing data and recommending changes.

B. A nuclear medicine technologist evaluates the performance of NaI (TI) scintillation probes, well counters and other laboratory equipment by:

1. calibrating a spectrometer with a calibrated, long half-life radionuclide source.

2. determining energy resolution.

3. conducting sensitivity measurements at appropriate energies.

4. checking background and determining the cause for levels greater than established normal levels.

5. conducting a chi-square test.

6. maintaining required records for quality control programs.

C. A nuclear medicine technologist operates survey meters by:

1. ensuring that calibration is completed with an approved source.

2. performing a check-source test and comparing with previous results.

3. maintaining required records for quality control program.

D. A nuclear medicine technologist evaluates the operation of a dose calibrator by:

1. determining precision (constancy).

2. determining accuracy.

3. ascertaining linearity over the entire range of radionuclide activity to be measured and determining correction factors when necessary.

4. testing for significant geometric variation in activity measured as a function of sample volume or configuration and determining correction factors when necessary.

5. maintaining required records for the quality control program.

E. A nuclear medicine technologist operates and maintains image processors by:

1. verifying the calibration of the instrument.

2. ensuring that materials required for image processing are at acceptable levels.

3. maintaining required records for quality control program.

III. Diagnostic Procedures and Adjunctive Medications

A. A nuclear medicine technologist performs imaging procedures by:

1. determining imaging parameters.

a) preparing, evaluating and properly administering the appropriate radiopharmaceuticals and/or pharmaceuticals and contrast (under the direction of an authorized user)

b) selecting the appropriate imaging or data collection parameters; and

c) establishing and/or properly maintain venous access routes of various configurations (in accordance with hospital policies and procedures)

2. administrating radiopharmaceuticals and/or pharmaceuticals through various routes, including but not limited to oral, intravesical, inhalation, intravenous, intramuscular, subcutaneous, and intradermal (under the direction of an authorized user).

a) verifying patient identity prior to the administration of medication or radiopharmaceuticals;

b) determining route of administration according to established protocol (e.g., subcutaneous, intramuscular, intravenous, etc.);

c) establishing and/or verifying venipuncture access using aseptic technique;

d) using and maintaining established venous access routes (e.g., heparin infusion, IMED);

e) establishing patient patterned breathing when introducing radiopharmaceuticals (e.g., inhalants or aerosols);

f) NMT also performs med reconciliation according to the procedure manual to assure no drug interaction with patient's current meds

g) administering oral radiopharmaceuticals;

h) Preparing and administering adjunctive pharmacologic agents including oral and IV contrast agents

i) properly documenting medications and/or radiopharmaceutical administrations on the patient medical record

3. Positioning the patient and obtaining images.

a) waiting an appropriate length of time following the administration of a radiopharmaceutical to begin the imaging procedure;

b) acquiring imaging views according to established protocols and acquiring additional views to optimize information content;

c) properly positioning the patient using supportive materials and immobilizers, as necessary;

d) exercising independent judgment in positioning a patient or detector unit to best demonstrate pathology and to adapt to the patient's limitations;

e) indicating appropriate anatomic landmarks for each view of the procedure; and

f) reviewing images to ensure that required information has been acquired, processed properly and is of the highest quality.

4. assisting in exercise and pharmacologic cardiac stress testing procedures

a) preparing patients for placement of ECG electrodes;

b) recognizing and responding to any ECG changes;

c) recognizing the parameters that indicate termination of cardiac stress study; and

d) recognizing ECG patterns that are appropriate for image gating.

e) determine whether the appropriate test has been ordered based on the ECG rhythm

5. performing data collection, processing and analysis.

a) performing data collection, processing and analysis in accordance with established protocols;

b) exercising independent judgment in selecting appropriate images for processing;

c) selecting appropriate filters, frequency cutoff, attenuation and motion correction when reconstructing SPECT images;

d) defining regions of interest (ROI's) with reproducible results and correctly applying background subtraction;

e) performing computer data manipulations as required by standard nuclear medicine procedures, e.g., activity curve generation, quantitation, SPECT slice production;

f) labeling processed images (e.g., anatomical positioning, ROI's, date, etc.);

g) processing PET data to produce parametric images; and

h) archiving and retrieving data from storage media.

B. A nuclear medicine technologist performs non-imaging in vivo and/or radioassay studies by:

1. operating laboratory equipment including well counters, probes, and other detection devices to measure the biodistribution of radiopharmaceuticals.

a) confirming accuracy, precision, and operation of pipetting device; and

b) using microhematocrit centrifuge and determining hematocrit.

2. preparing doses and guidelines.

   a) quantitating dose:

      (i) determining decay factor and calculating remaining activity;

      (ii) determining volume necessary to deliver activity for the prescribed dose;

      (iii) drawing dose into syringe using appropriate techniques and materials;

      (iv) dispensing appropriate quantity of liquid or capsules, as necessary, for the prescribed dose;

      (v) confirming calculated activity by using a dose calibrator.

   b) preparing standard solutions.

      (i) choosing appropriate volumetric or gravimetric techniques to dilute standard;

      (ii) adding radioactive material identical to that given the patient quantity sufficient (qs) to appropriate volume; and

      (iii) dissolving capsule in appropriate solvent, if necessary, for preparing a standard

3. collecting appropriate specimen for procedures using standard precaution techniques by:

   a) collecting blood samples.

      (i) selecting proper supplies (e.g., needles, syringes, evacuated tubes, anticoagulants, etc.);

      (ii) Correctly identify patient and labeling patient demographics on collection containers;

      (iii) performing venipuncture at appropriate time intervals using aseptic technique;

      (iv) adding hemolyzing compounds or anticoagulants to samples when necessary;

(v) centrifuging blood and separating blood components, as required; and

(vi) storing aliquots of serum, plasma, or whole blood according to protocol.

b) collecting urine samples by:

(i) instructing patient and nursing staff regarding the correct method and time of urine collection;

(ii) aliquoting urine sample and measuring total urine volume;

(iii) measuring specific gravity of urine, if required; and

(iv) recognizing and documenting all technical circumstances which would produce invalid results.

4. gathering, validating and documenting data.

a) subtracting room or patient background from appropriate samples;

b) applying appropriate formulas, including conversion and dilution factors;

c) calculating results according to procedure used;

d) plotting graph, if necessary, and determining half time by extrapolating to zero time;

e) reporting both patient calculated values and normal range of specific procedures used; and

f) evaluating results for potential error.

5. managing bio-hazardous, chemical and radioactive waste in accordance with applicable regulations and specific facility policy.

IV. Radiopharmaceuticals

A. A nuclear medicine technologist displays:

1. thorough knowledge of molecular level physiological functions that relate to glucose metabolism, blood flow, brain oxygen utilization, perfusion, and receptor-ligand binding rates.

2. thorough knowledge of physiological and processes that relate to organ system function and anatomy and their radiopharmaceutical demonstration of normal and pathologic states.

B. A nuclear medicine technologist procures and maintains radiopharmaceutical products and adjunct supplies by:

1. anticipating and procuring a sufficient supply of radiopharmaceuticals for an appropriate time period in accordance with anticipated need and license possession limits.

2. storing pharmaceuticals, radiopharmaceuticals and supplies in a manner consistent with labeled product safeguards and with radiation safety considerations.

3. performing and documenting radiation survey and wipe tests upon receipt of radioactive materials.

4. recording receipt of radioactive materials in a permanent record.

5. following Department of Transportation (DOT) and radiation safety guidelines in the transport, receipt and shipment of radioactivity.

C. A nuclear medicine technologist properly prepares and administers diagnostic radiopharmaceuticals under the direction of an authorized user in accordance with all federal, state and institutional gudielines by:

1. employing aseptic technique for manipulation of injectable products.

2. assembling and maintaining radionuclide generators.

3. eluting radionuclide generators according to manufacturer's specification.

4. verifying radionuclide purity of generator eluates.

5. selecting and preparing radiopharmaceuticals in accordance with manufacturer's specifications.

6. measuring and calculating activity of the radionuclide with a dose calibrator.

7. confirming the quality of a radiopharmaceutical in accordance with accepted techniques and official guidelines (e.g., radiochemical purity, physical appearance).

8. preparing blood or blood products for labeling and/or labeled blood cells,

e.g., ^{111}Indium WBC in accordance with established protocols.

9. recording use and/or disposition of all radioactive materials in a permanent record.

D. A nuclear medicine technologist is responsible for the identification and labeling of all radiopharmaceutical preparations by:

1. labeling vials and syringes as required by regulation.

2. recording radiopharmaceutical and medication information on a patient's administration form and permanent preparation records.

3. labeling and segregating radioactive waste and recording this information in a permanent record.

E. A nuclear medicine technologist prepares individual dosages under the direction of an authorized user or Radiation Safety Officer by:

1. applying radioactive decay calculations to determine required volume or unit form necessary to deliver the prescribed radioactive dose.

2. selecting and preparing prescribed dosages and entering this information on a patient's administration form and other permanent records.

3. labeling the dose for administration.

4. checking the dose activity prior to administration in a dose calibrator and comparing this measurement against the identification label of the dose's immediate container.

V. Radionuclide Therapy

A. Nuclear medicine technologist properly prepares and administers therapeutic radionuclides, radiopharmaceuticals, and pharmaceutical agents by oral and/or intravenous routes when these agents are part of a standard procedure that is required for treatment under the direction of an authorized user in accordance with federal, state, and institutional regulations by:

1. assuring that the correct radiopharmaceutical and dosage is prepared.

2. following the NRC mandated quality management program in effect at the facility in regard to patient identification and the use of therapeutic radionuclides.

3. observing prescribed radiation safety procedures during the preparation and the administration of such treatment.

4. assisting the authorized user in supplying proper patient care instructions to hospital staff, patient, and/or caregivers.

5. conducting and documenting radiation surveys of designated patient areas, when indicated.

6. Instruct the patient, family and staff in radiation safety precautions after the administration of therapeutic radiopharmaceuticals.

7. coordinating/scheduling pre/post treatment blood draws and/or imaging.

VI. Radiation Safety

A. A nuclear medicine technologist performs all procedures utilizing ionizing radiation safely and effectively, applying federal, state, and institutional regulations, including, but not limited to:

1. notifying appropriate authority when changes occur in the radiation safety program.

2. assisting in the preparation of license amendments, when necessary.

3. keeping up to date on regulatory changes and by complying with all applicable regulations.

4. maintaining required records.

5. posting appropriate signs in designated areas.

6. following regulations regarding receipt, disposal and usage of all radioactive materials.

7. carrying out a program to follow regulations regarding therapeutic procedures and follow-up.

8. recommending purchase of protection equipment to meet regulations.

9. packaging radioactive material according to regulations and keeping accurate records of transfer.

B. A nuclear medicine technologist follows appropriate radiation protection procedures by:

1. using personnel monitoring devices (dosimeters, film badges, thermoluminescent dosimeters, etc.).

    a) reviewing monthly personnel exposure records in regard to maximum permissible dose limits;

    b) taking appropriate measures to reduce exposure, when necessary; and

    c) notifying proper authorities of excessive exposure upon occurrence;

2. selecting and using proper syringe shields and other shielding configurations to reduce radiation exposure to patients, personnel and the general public.

3. identifying specific radionuclides emissions and energies per radiopharmaceutical (gamma, beta, positron) and using proper shielding and disposal procedures in compliance with NRC regulations to maximize patient, technologist, and public protection.

4. performing technologist bioassays as per state and/or federal regulations.

5. working in a safe, but timely manner in order to decrease radiation exposure in consideration of ALARA programs.

6. reviewing personal monitoring device readings to determine if radiation exposure can be further reduced.

7. working in a manner that minimizes potential contamination of patients, technologists, the public, and work areas.

C. A nuclear medicine technologist performs radioactivity contamination monitoring by:

1. ensuring that instruments are calibrated at regular intervals, or after repairs according to regulations.

2. setting frequency and locations for surveys and following schedules.

3. using appropriate survey meters for each type and level of activity.

4. following regulations regarding personnel surveys and reporting to the designated authorized user or Radiation Safety Officer.

5. performing constancy checks on survey meters.

6. performing wipe tests where applicable.

7. performing leak tests on sealed sources, when so authorized.

8. recording data in required format (e.g., dpm instead of cpm).

9. evaluating results of wipe tests and area surveys to determine if action is required.

10. notifying the Radiation Safety Officer when actions are required.

D. A nuclear medicine technologist performs decontamination procedures by:

1. wearing personal protective equipment as necessary.

2. restricting access to affected area and confining a spill.

3. removing contamination and monitoring the area and personnel and repeating decontamination procedure until activity levels are acceptable.

5. closing off all areas of fixed contamination that are above acceptable levels, and posting appropriate signs.

6. identifying, storing, or disposing of contaminated material in accordance with regulations.

7. maintaining adequate records concerning decontamination.

8. notifying appropriate authority (e.g., Radiation Safety Officer) in the event of possible overexposure or other violations of regulations.

E. A nuclear medicine technologist disposes of radioactive waste in accordance with federal, state and institutional regulations by:

1. maintaining appropriate records.

2. disposal according to license specifications.

3. maintaining long- and short-term storage areas according to regulation.

F. A nuclear medicine technologist participates in programs designed to instruct other personnel about radiation hazards and principles of radiation safety by:

1. using the following teaching concepts

    a) types of ionizing radiation;

    b) the biological effects of ionizing radiation;

    c) limits of dose, exposure, and radiation effect;

    d) concepts of low-level radiation and health; and

    e) concept of risk versus benefit.

2. providing instruction on appropriate radiation safety measures.

3. providing instruction on proper emergency procedures to be followed until radiation safety personnel arrive at the site of accident or spill.

4. modeling proper radiation safety techniques and shielding in the course of daily duties.

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Statutory Recognition 3/12/2013

PURPOSE:

The overall purpose of this Statutory Recognition legislation is to provide the public with a safe delivery of healthcare services and medical imaging in the Nuclear Medicine environment. This legislation will establish a minimum standard for any person practicing nuclear medicine imaging in the State of Connecticut. It will state the education and certification minimums to be achieved by a nuclear medicine technologist. By establishing these standards the public will be assured safe, quality services, reduced healthcare costs by lowering the number of repeated procedures due to poor technique and will be confident of the technologist performing their diagnostic imaging and therapeutic services.

What is Nuclear Medicine?

Nuclear medicine, which includes molecular imaging, is the medical specialty that utilizes sealed and unsealed radioactive materials in the diagnosis and therapy of various diseases. This practice also includes the utilization of pharmaceuticals (used as adjunctive medications) and other imaging modalities with or without contrast to enhance the evaluation of physiologic processes at a molecular level.

The practice of nuclear medicine technology requires multidisciplinary skills that are needed to use rapidly evolving instrumentation, radiopharmaceuticals, adjunctive medications and techniques. The responsibilities of the nuclear medicine technologist include, but are not limited to, patient care, quality control, diagnostic procedures, radiopharmaceutical and adjunctive medication, preparation and administration, in vitro diagnostic testing, radionuclide therapy, and radiation safety. The nuclear medicine technologist can also participate in research.

What is a Nuclear Medicine Technologist?

The nuclear medicine technologist is an allied health professional, certified in nuclear medicine technology , who under the direction of an authorized user, is committed to applying the art and skill of their profession to optimize diagnostic evaluation and therapy through the safe and effective use of radiopharmaceuticals and adjunctive medications.

The nuclear medicine technologist calibrates, dispenses and administers radiopharmaceuticals, pharmaceuticals and radionuclides under the supervision of an authorized user for the benefit of performing a comprehensive scope of nuclear medicine procedures.

When caring for a patient, the technologist will review the patient's medical history to understand the patient's illness and pending diagnostic procedure or therapy, instruct the patient before, during and following the procedure, evaluate the satisfactory preparation of the patient before beginning a procedure, and recognize emergency patient conditions and initiate lifesaving first aid when appropriate.

Administrative functions may include supervising other nuclear medicine technologists, students, and other personnel; participating in procuring supplies and equipment; documenting laboratory operations; participating in departmental inspections conducted by various licensing, regulatory, and accrediting agencies; and participating in scheduling patient examinations.

Definitions:

ALARA– Acronym for **A**s **L**ow **A**s **R**easonably **A**chievable. This is a radiation safety principle for minimizing radiation doses and releases of radioactive materials by employing all reasonable methods.

Authorized User – A physician authorized by a radioactive materials license issued under the applicable regulations to use radiopharmaceuticals for diagnostic studies and /or therapeutic treatments.

Computed Tomography - A medical imaging technology that uses a computer to acquire a volume of x-ray based images, generally reconstructed as two-dimensional (2D) or three dimensional (3D) pictures of inside the body. These images can be rotated and viewed from any angle. Each CT image is effectively a single 'slice' of anatomy.

Diagnostic Imaging - Diagnostic imaging uses technologies such as x-ray, CT, MRI, ultrasound, PET and SPECT to provide physicians with a way to look inside the body without surgery. Diagnostic imaging is considered a non-invasive diagnostic technique, as opposed to a biopsy or exploratory surgery. PET, SPECT and some types of MR imaging also provide information about how certain tissues and organs are functioning.

Hybrid/Fusion Imaging - The combination of the two imaging technologies that allows information from two different studies to be viewed in a single set of images. These include PET/CT, SPECT/CT and PET/MRI imaging systems

Hybrid/Fusion Nuclear Medicine Technologist - means a person other than a licensed practitioner who is a nuclear medicine technologist and who is qualified by additional education, training or experience, as stated in this document, to use hybrid/fusion technology.

Imaging Device - A technological apparatus used to produce detailed images of the inside of the body for diagnostic or therapeutic purposes. In molecular imaging, examples of these devices include the gamma camera, CT scanner, PET scanner, MRI unit, optical imaging detector, and ultrasound machine.

Isotope - Atoms of a single element that have differing masses. Isotopes are either stable or unstable (radioisotope). Radioisotopes are radioactive: they emit particulate (alpha, beta) or electromagnetic (gamma) radiation as they transform or decay into stable isotopes.

Magnetic Resonance Imaging – Magnetic resonance imaging is a diagnostic scan that uses high-strength magnetic fields rather than radiation. MRI techniques are used primarily to study anatomy, but a special type of MR scan, functional MRI (fMRI) can be used to map blood flow for functional studies.

Molecular Imaging – Molecular imaging is an array of non-invasive, diagnostic imaging technologies that can create images of both physical and functional aspects of the living body. It can provide information that would otherwise require surgery or other invasive procedures to obtain. Molecular imaging differs from microscopy, which can also produce images at the molecular level, in that microscopy is used on samples of tissue that have been removed from the body, not on tissues still within a living organism. It differs from X-rays and other radiological techniques in that molecular imaging primarily provides information about biological processes (function) while CT, X-rays, MRI and ultrasound, image physical structure (anatomy). Molecular imaging technologies include traditional nuclear medicine, optical imaging, magnetic resonance spectroscopy, PET and SPECT.

Nuclear Medicine - The use of very small amounts of radioactive materials (called radiopharmaceuticals or radiotracers) to evaluate molecular, metabolic, physiologic and pathologic conditions of the body for the purposes of diagnosis, therapy and research. Nuclear medicine procedures can often identify abnormalities very early in the progression of a disease — long before many medical problems are apparent with other diagnostic tests.

Positron Emission Tomography – Positron emission tomography (PET) is a medical imaging technology that uses radiopharmaceuticals that emit positrons (positively charged electrons). A radiopharmaceutical such as FDG is injected into the patient. The fluorine emits positrons which react with the first electron they come in contact with, annihilating both and producing energy according to Einstein's famous E=mc2 formula. This energy takes the form of two photons (particles of light) with a very specific energy level that shoot off in opposite directions. When these photon pairs are detected by the PET scanner, the location of the original fluorine atom can be extrapolated. Although positron/electron annihilation is one of the most powerful reactions known to science, the amount of mass involved is so small that the actual energy produced is not harmful to the patient, and the fluorine decays rapidly into harmless oxygen.

Sealed source - any radioactive material that is encased in a capsule designed to prevent leakage or escape of the radioactive material.

Unsealed Source – any soluble form of radioactive substances, which are administered to the body by injection or ingestion. Such substances are typically used for their biological properties, for diagnostic imaging and therapeutic purposes.

Education:

Education includes, but is not limited to, methods of patient care, immunology, cross sectional anatomy, pharmacology, nuclear medicine and radiation physics, radiation biology, radiation safety and protection, nuclear medicine instrumentation, quality control and quality assurance, computer applications for nuclear medicine, general diagnostic nuclear medicine procedures, radionuclide therapy, positron emission tomography (PET), computed tomography (CT), magnetic resonance imaging (MRI), radionuclide chemistry, radiopharmacy, medical ethics and law, healthcare administration, health sciences and research methods, and medical informatics.

Nuclear Medicine Technologists may complete a one- or two-year certificate program, a two year associate's degree, or a four-year bachelor's degree.

Additional education will be required of a Hybrid/Fusion Nuclear Medicine Technologist who operates a hybrid/fusion imaging system. This additional education will be in the areas of either CT or MRI and will include both a didactic and competency component. Due to their preliminary education, a nuclear medicine technologist is already qualified to operate the PET portion of a hybrid/fusion imaging system. After the successful completion of this education the technologist must pass the individual certification exam for either CT or MRI administered by the American Registry of Radiologic Technologists (ARRT).

In the State of Connecticut, the successful passing of the certification exam for CT will allow the Hybrid/Fusion Nuclear Medicine Technologist the ability to fully operate the CT portion of a hybrid/fusion imaging system, including diagnostic imaging, in conjunction with a PET or SPECT imaging system and not a stand-alone CT imaging system.

Certification and other Qualifications:

Each person shall complete a course of study in an accredited nuclear medicine program and then obtain certification from the Nuclear Medicine Technology Certification Board (NMTCB) and/or the American Registry of Radiologic Technologists (ARRT)

The ARRT and NMTCB have different eligibility requirements, but both require that workers pass a comprehensive exam with an overall score of 75 or better to become certified.

In addition to the general certification requirements, certified technologists also must complete a certain number of continuing education hours to retain certification. Continuing education is required primarily because of the frequent technological and innovative changes in the field of nuclear medicine.

Permitted Activities:

The permitted activities based on the **scope of practice** in nuclear medicine technology includes, but is not limited to, the following areas and responsibilities:

• **Patient Care:** Requires the exercise of judgment to assess and respond to the patient's needs before, during and after diagnostic imaging and therapeutic procedures and in patient medication reconciliation. This includes record keeping in accordance with the Health Insurance Portability and Accountability Act (HIPAA).

• **Quality Control:** Requires the evaluation and maintenance of a quality control program for all instrumentation to ensure optimal performance and stability.

• **Diagnostic Procedures:** Requires the utilization of appropriate techniques, radiopharmaceuticals and adjunctive medications as part of a standard protocol to ensure quality diagnostic images and/or laboratory results.

• **Radiopharmaceuticals:** Involves the safe handling and storage of radioactive materials during the procurement, identification, calibration, preparation, quality control, dose calculation, dispensing documentation, administration and disposal.

• **Adjunctive Medications:** When used within the context of a Nuclear Medicine study protocol, involves the identification, preparation, calculation, documentation, administration and monitoring of adjunctive medication(s) used during an in-vitro, diagnostic imaging, or therapeutic procedure. Adjunctive medications are defined as those medications used to evoke a specific physiological or biochemical response. Also included are the preparation and administration of oral and IV contrast used in the performance of imaging studies.

• **In Vitro Diagnostic Testing:** Involves the acquisition of biological specimens with or without oral, intramuscular, intravenous, inhaled or other administration of radiopharmaceuticals and adjunctive medications for the assessment of physiologic function.

• **Operation of Instrumentation:** Involves the operation of:
• Imaging instrumentation:
o Gamma camera systems with or without sealed sources of radioactive materials or x-ray tubes for attenuation correction, transmission imaging or diagnostic CT (when appropriately educated, trained and credentialed).

o PET imaging systems with or without sealed sources of radioactive materials or x-ray tubes for attenuation correction, transmission imaging or diagnostic CT (when appropriately trained and credentialed).
o PET imaging systems in conjunction with an MRI imaging system.

• Non-imaging instrumentation:
o Dose calibrators
o Survey instrumentation for exposure and contamination
o Probe and well instrumentation
o Ancillary patient care equipment as authorized by institutional policies.

• **Radionuclide Therapy:** Involves patient management, preparation and administration of therapeutic radiopharmaceuticals, under the personal supervision of the Authorized User

• **Radiation Safety:** Involves practicing techniques that will minimize radiation exposure to the patient, health care personnel and general public, through consistent use of protective devices, shields, and monitors consistent with ALARA (as low as reasonably achievable) and establishing protocols for managing spills and unplanned releases of radiation.

Prohibited Activities:

Any activity not included in the Scope of Practice for Nuclear Medicine Technologists practicing in the State of Connecticut.